Amendments to the Drawings

FIGS. 6 and 8 have been amended. In FIG. 6, a reference numerals 610 and 620 have been added, and each of the boxes in the right-most vertical column of boxes is labeled "MUX." In addition, amended FIG. 6 now shows a box labeled Hue Angle Converter 410 (from FIG. 4) which provides an input to each MUX.

These amendments to FIG. 6 conform the drawing to the specification at paragraph [046] where it states, as now amended herein:

> 3x3 matrix multiplier 610 performs the 9 multiplies (and several additions to complete a matrix multiply) and outputs 3 values. These three values are distributed as the 6 output signals by 6 multiplexors. The multiplexors also use the chromaticity triangle number produced by Hue Angle Converter 410 as their input to select different values.

The chromaticity triangle is discussed further at paragraph [041], which states in part:

> [041] To convert a CIE XYZ value to multi-primary, it is desirable to determine which chromaticity triangle the color is in and use the corresponding matrix to do the conversion in Equation 8. … The input color values can be converted to some hue based color co-ordinate system and then the hue angle could be used to determine which triangle the color is in.

The hue angle calculator is discussed in paragraph [042]. While the specification refers to a hue angle calculator, Applicant has used the term "Hue Angle Converter" in FIG. 6 to conform the name of the function in FIG. 6 to the implementation illustrated in original FIG. 4.

FIG. 8, which shows an implementation specific to an output color space defined by R, G, B and W primary colors, has been amended in a manner similar to FIG. 6. Reference numeral 810 has been added, the W component selection box is labeled "MUX," with added reference numeral 820, and a box labeled Hue Angle Converter 410 (from FIG. 4), which provides an input to MUX 820, has been added to

FIG. 8. The implementation of FIG. 8 is discussed in paragraph [047] of the specification, which states, as now amended herein:

> [047] FIG. 7 shows the special case for RGBW when W (white) is one of the primaries. The W row of coefficients in each matrix of FIG. 7 typically contains a row identical to one of the other rows in the matrix, with the identical rows shown shaded in the matrices on the left side of FIG. 7. The W row, therefore, can be removed from each of the original matrices to form the 3x3 matrices. Also in the case of RGBW, only 3 rows remain after removing the W row of coefficients, and these three rows can be kept in their original order. Because of this, the multiplexors for R G and B are not required in the RGBW implementation, as shown in FIG. 8. Only one multiplexor 820 for W may be desirable to choose the correct value from the other primaries.

In addition to the Replacement Sheets, Applicant is also submitting annotated versions of FIGS. 6 and 8 showing the amendments that have been made to these Figures herein, for the convenience of the Examiner.

Attachments by separate submission:

Two (2) Replacement Sheets including FIGS. 5 and 6, and FIGS. 7 and 8.

Two (2) Annotated Sheets showing changes made to FIGS. 6 and 8.

REMARKS

This Reply is responsive to the Office Action mailed March 6, 2007. Reconsideration of the rejections set forth therein is respectfully requested in view of the amendments made to the claims and the following remarks.

Amendments to the Specification

Paragraphs [046] and [047] have been amended in order to conform these paragraphs to the amended drawings of FIGS. 6 and 8.

Applicants believe that none of these amendments adds new matter to the application.

Amendments to the Claims

Claims 1 – 21 and 30 - 33 are pending in the present application. Claims 22 – 29 were previously canceled in response to a restriction requirement.

Applicant has made amendments to Claims 1 and 21 that are primarily cosmetic in nature in order to respond to the Section 101 rejection, as discussed more fully below. Claim 6 has been amended to respond to the Section 112 rejection, as discussed further below. Claim 11 has been amended to correct internal language inconsistencies.

Applicant believes that none of these amendments to the claims adds new matter to the application.

Amendments to the Drawings

FIGS. 6 and 8 have been amended, as described above in the "Amendments to the Drawings" section of this Reply. Two (2) Annotated Sheets showing the original figures marked up with the changes and two (2) Replacement Sheets showing the amended drawings are submitted concurrently with this Reply.

Applicants believe that none of these amendments to the drawings introduces new matter into the application.

Claim Rejection under 35 U.S.C. § 112, second paragraph

The Office Action rejects Claim 6 under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. In particular, the Office Action states that there is insufficient antecedent basis for the language "bounded by said at least three primaries."

Claim 6 has been amended to conform the language therein to the language in claim 1, from which it depends. Applicant believes that this amendment overcomes the rejection, and respectfully requests that the rejection be withdrawn.

Claim Rejections under 35 U.S.C. § 101

The Office Action rejects Claims 1 – 10, 21 and 30 – 31 under 35 U.S.C. § 101 as being directed to non-statutory subject matter.

With respect to independent claims 1 and 21, the Office Action states that the language of the claims raises questions as to whether the claims are directed merely to an abstract idea that is not tied to a technological art, environment or machine that would result in a practical application producing a concrete, useful and tangible result, which is required to form the basis of statutory subject matter under 35 U.S.C. § 101. The Office Action further states that

> the method and system for converting from a source color space to a target color space are directed to a mathematical procedure, which is an abstract idea that does not correspond to any specific real world data, and these claims to not claim any "practical application" or "useful, concrete and tangible result." See MPEP 2106 IV (B)(1).

(Office Action at page 5, emphasis added.) Dependent claims 2 – 10 and 30 – 31 are rejected for the same reasons given for their respective independent claims.

Applicant respectfully submits that the method and system of these claims do not operate on abstract numbers, and that these claims do not merely recite a mathematical procedure. Rather, the method and system convert source color points

in source image data from a source color space to a target color space. Applicant has amended claims 1 and 11 with what are intended to be cosmetic changes that more specifically identify the "real world data" on which the method and system of these claims operate and produce. In claim 1, the method produces an output color point from a given source color point. In claim 21, the system converts source image data color points from the N-primary source color space into image data values for rendering in the at least N+1 primary target color space using one of a plurality of conversion matrices. Applicant respectfully submits that both of these claims produce a useful, concrete and tangible result of output image data that is in the form needed to render in the target color space defined by the at least N+1 target primaries.

Applicant further respectfully submits that the claims must be read in light of the specification as a whole. As noted in paragraph [014] of the specification, "[a] method and apparatus is provided to convert existing three valued color data into multi-primary data for this new class of displays. The present method and apparatus will work for multi-primary displays with any number of color primaries." FIG. 4 illustrates the component functional parts, referred to in the specification as a "gamut pipeline," of a display system that provides the functionality described in the specification. Thus, claims 1 and 21 clearly operate in the real world and produce useful, concrete and tangible results.

Applicant has not amended claims 1 and 21 to specifically include reference to a display panel or output display device on which the output color data is displayed. Claims 1 and 21 define inventions that may be used as a component part of a variety of image processing systems without this specific component including a display function. Applicant respectfully submits that it is sufficient under Section 101 for the method step and component part as defined in claims 1 and 21 to produce the output color value for use by another method step or system component, without the need for the claims to contain a method step or system component to actually display the output color.

Moreover, these claims are far from being exclusively a "mathematical procedure," as stated in the Office Action. In determining the eligibility of the method and system set forth in claims 1 and 21 for patent protection under Section 101, these claims must be considered as a whole. The method steps and system components in these claims operate on source image data, and not on mere numbers or abstract concepts. They may use some mathematical operations to achieve the results, but the mere use of mathematical terminology does not render a claim a "mathematical procedure." The Office Action has not stated any law of nature or abstract idea that is being pre-empted by claims 1 and 21, and also has not shown that the method steps and unit components in these claims consist solely of mathematical operations. In addition, the output image data result in each claim is concrete because the operation as set forth in each claim is repeatable.

The Office published **Interim Guidelines for Examination of Patent Applications for Patent Subject Matter Eligibility**, 1300 Off. Gaz. Pat. Office 142 (Nov. 22, 2005), and subsequently incorporated much of this document in MPEP Chapter 2100. The Guidelines provide suggestions as to how to analyze and frame a Section 101 statutory subject matter rejection. Annex V of the Guidelines (MPEP 2106.2) is directed to Mathematical Algorithms, and is thus relevant to the present discussion. Annex V states in relevant part:

> Claims to processes that do nothing more than solve mathematical problems or manipulate abstract ideas or concepts are complex to analyze and are addressed herein.
>
> If the "acts" of a claimed process manipulate <u>only numbers, abstract concepts or ideas</u>, or signals representing any of the foregoing, the acts are not being applied to appropriate subject matter. *Gottschalk v. Benson*, 409 U.S. 63, at 71-72, 175 USPQ 673 at 676 (1972). Thus, a process consisting <u>solely</u> of mathematical operations, i.e., converting one set of numbers into another set of numbers, does not manipulate appropriate subject matter and thus cannot constitute a statutory process.
>
> In practical terms, claims define nonstatutory processes if they:
>
> - consist solely of mathematical operations without some claimed practical application (i.e., executing a "mathematical algorithm"); or

> - simply manipulate abstract ideas, e.g., a bid (*Schrader*, 22 F.3d at 293-94, 30 USPQ2d at 1458-59) or a bubble hierarchy (*Warmerdam*, 33 F.3d at 1360, 31 USPQ2d at 1759), without some claimed practical application.

MPEP 2106.2, pg. 2100-19 (emphasis added.) Applicant respectfully submits that claims 1 and 21 cannot reasonably be interpreted as falling within the language quoted above.

Applicant has made a good faith effort to make cosmetic changes to claims 1 and 21 that more specifically recite the data on which these claims operate. Applicant respectfully submits that these amendments and the discussion above are sufficient for the rejection under Section 101 of claims 1 and 21 to be withdrawn. If the Examiner maintains this rejection in a future Office Action, Applicant respectfully requests that the Office Action provide specific guidance as to what claim language would overcome the Section 101 rejection.

<u>Claim Rejections under 35 U.S.C. § 103</u>

<u>Claims 1 and 11</u>

The Office Action rejects Claims 1 – 9 and 11 - 19 under 35 U.S.C. § 103 as being unpatentable over Childs et al. (GB 2,282,928 A), hereinafter referred to as Childs, in view of Yanagawa et al. (US 5,694,186) hereafter referred to as Yanagawa.

Claim 1 contains the steps of defining an interior color point positioned in the interior of the boundary of said target color space, dividing said target color space into a set of regions that are bounded by at least two of the at least N+1 target primaries and by said interior color point, calculating a solution matrix for each said region, for a given source color point in said source color space, selecting one of said solution matrices for rendering said source color point in said target color space, and computing an output color point using said source color point and said selected solution matrix.

Claim 11 comprises processing circuitry that is configured to define an interior color point positioned in the interior of the boundary of said target color space, and to

divide said target color space into a set of regions that are bounded by at least two of the at least N+1 target primary color points and by said interior color point. The processing circuitry is further configured to calculate a solution matrix for each region, and to select one of said solution matrices for rendering a source color point on said display panel defined by said target primary color points.

Each of these claims contains a limitation regarding dividing the target color space into a set of regions that are bounded by at least two of the at least N+1 target primary color points and by an interior color point. For brevity, this limitation will be referred to in these Remarks as the limitation of "dividing the target color space into regions."

The teachings of the Childs and Yamagawa references with respect to the claim limitation of dividing the target color space into regions in Claims 1 and 11.

Childs discloses a video display apparatus that receives a transmitted color video signal coded using three system primaries Rs, Gs, Bs and decodes the signal for display on a device using four display primaries. The four display primaries are independent, in that no display primary can be expressed as a combination of another two display primaries, and so define a quadrilateral in a chromaticity diagram. (Childs, Abstract.)

In Applicant's prior reply filed on 20 December 2006, Applicant agreed that the Childs reference discloses a color space formed by the four display primaries R_d, G_{1d}, G_{2d} and B_d in FIG. 5 that meets the limitation of claim 1 of defining a set of at least N+1 target primaries that form the boundary of the target color space. Applicant argued, however, that Childs does not disclose dividing said target color space into a set of regions that are bounded by at least two primary color points and an interior color point. The current Office Action concedes that Childs does not teach this step, at page 7 ("Childs does not explicitly disclose that the color space is divided into regions [defined by] at least two primaries and the interior color point.")

The Office Action, at page 7, cites the Yanagawa reference as teaching the limitation of dividing [a color space into] triangle[s] with vertices at the points R', G'

and B', which is the gamut of reproducible colors (citing FIG. 2, col. 5, lines 60 – 67, col.6, lines 1 -12; FIG. 2 shows the primary colors R', G' and B' and white W' dividing the gamut triangle into three regions with W' as the interior point.) The Office Action, at page 6, also states that

> FIG. 5 [in the Childs reference] shows that the triangles are formed comprising two primaries and an imaginary primary G_{3d}, but do not include the interior color point; however, it [FIG. 5] shows how to divide [a color space] into regions using two of at least N+1 primaries and a third color point which resides on the boundary of the target color space.

Then the Office Action concludes that

> It would have been obvious to one of ordinary skill in the art at the time of the present invention to divide the color space using at least two primaries and a point in the interior of the boundary of the color space, instead of using the imaginary primary G_{3d}, which lies on the boundary of the color space. Applicant has not disclosed that dividing the color space using a point lying in the interior of the boundary of the color space provides an advantage, is used for a particular purpose, or solves a stated problem. One of ordinary skill in the art, furthermore, would have expected applicant's invention to perform equally well with Childs reference that teaches dividing the color space using at least two primaries and an imaginary primary on the boundary of the color space because using this imaginary primary of Childs will also result in dividing the color space. Therefore it would have been obvious to one of ordinary skill in the art to modify Childs to obtain the invention as specified in claim 1.

Office Action, at pages 7 – 8.

Applicant interprets the Office Action to state the following argument: Childs teaches how to divide a multiprimary color space into regions using color points on the boundary of the color space. Yanagawa teaches dividing a color space into regions using an interior color point. So Childs can be modified by Yanagawa to produce the claimed invention because "Applicant has not disclosed that dividing the color space using a point lying in the interior of the boundary of the color space provides an advantage, is used for a particular purpose, or solves a stated problem" and "[o]ne of ordinary skill in the art …would have expected applicant's invention to

perform equally well with Childs reference that teaches dividing the color space using at least two primaries and an imaginary primary on the boundary of the color space."

Applicant respectfully traverses the Section 103 rejection as to the interpretation in the Office Action of the teachings of the Childs and Yanagawa references. Applicant respectfully submits that the Office Action does not state a *prima facie* case for a Section 103 rejection.

The Office Action seems to suggest that whether the target color space regions are defined by all target color space primary color points, as in Childs, or at least two primary color points and an interior color point, as in Applicant's claims, is of little significance, since Applicant has not "disclosed that dividing the color space using a point lying in the interior of the boundary of the color space provides an advantage, is used for a particular purpose, or solves a stated problem" As a preliminary matter, Applicant is not required to make such a disclosure in order to obtain patent coverage for his invention under Title 35.

Secondarily, the statement in the Office Action that "[o]ne of ordinary skill in the art …would have expected applicant's invention to perform equally well with Childs reference that teaches dividing the color space using at least two primaries and an imaginary primary on the boundary of the color space" is somewhat contradicted by the Childs reference itself. Assume for the sake of argument herein that the interior color point in the target color space is the white point of the display. Childs states that

> 3. Multi-primary analysis method
>
> The multi-primary problem can be overcome by dissecting the colour gamut of the display into triangles formed by sets of three of the display primaries, and using any analysis which produces only positive drive signals. *Unfortunately, not all of the triangles thus formed will contain the balance point of the system and so the mathematics of Section 2 cannot be used directly, also it may be difficult to set up the display device in practice*. For a multi-primary display there are several solutions to this.

> The display may be made using three primaries at a time forming triangles which do not overlap; overlapping triangles are then required only for setting up the display. This approach, of using contiguous non-overlapping triangles, might cause some difficulties if the implementation of the following mathematics is not sufficiently accurate; noise could cause fast switching between triangles resulting in unfamiliar effects.
>
> As an alternative, overlapping triangles can be used and the switching between triangles can then employ hysteresis to avoid these effects. It is possible to calculate an analysis for a triad which uses two real primaries and one synthetic primary, made by linearly mixing two others.
>
> The calculation processes required to produce the matrices which connect the transmission signals with the display primaries is as described in Section 2. The concept of balancing each display primary triad individually to an illuminant is retained, even though not all of the triads contain the white point. Any triad not containing the white point will produce a column in the display matrix containing only negative numbers, and the appropriate multiplier (1, m or n) is negative. This is only a mathematical problem, and does not render the problem insoluble as is shown below.

Childs, at pp. 8 – 9; emphasis added. The term "balance point" refers to the illuminant, i.e., the white point, of the display. Childs' technique of dividing the target color space into regions using combinations of display primaries at the boundary of the target color space thus recognizes that the problems created by not including the balance point of the target display in each region must be compensated for in the mathematics of the matrices. Applicant respectfully submits that Childs teaches one of ordinary skill in the art <u>not</u> to expect that dividing the color space using at least two primaries and an imaginary primary on the boundary of the color space works equally as well as when each triangular region includes the balance point (an interior point) of the display color space.

By raising this argument, Applicant is not implying that the interior point referenced in the subject claims must always be the white point of the display defined by the target color space. Indeed, Applicant's specification states that this is not a requirement. Applicant is merely pointing out that the Childs reference explicitly discusses the potential deficiency in creating triangular color space regions using

display primaries on the boundary of the color space when the triangles so created do not include the white point of the display. Presumably, Childs had the opportunity to consider triangles defined by different color points in the target color space, including an interior color point, and did not state that such regions were a reasonable alternative.

The Office Action cites the Yanagawa reference as teaching the limitation of dividing [a color space into] triangle[s] with vertices at the points R', G' and B', which is the gamut of reproducible colors (citing FIG. 2, col. 5, lines 60 – 67, col.6, lines 1 - 12; FIG. 2 shows the primary colors R', G' and B' and white W' dividing the gamut triangle into three regions with W' as the interior point.)

However, the Yanagawa reference is clearly concerned with the traditional three-primary color space. FIG. 2 clearly shows a color gamut defined by R', G' and B' primary colors. Yanagawa states

> FIG. 2 is a so-called CIE 1931 chromaticity diagram, R', G', B' and W' indicate chromaticities of colors of red, green, blue and white displayed in their maximum brightness (i.e., three display primaries and white) and viewed in a direction normal to the liquid crystal display panel 100, respectively. *A triangle with vertices at the points R', G' and B' is a gamut of reproducible colors* viewed in the normal direction of the liquid crystal display panel.
>
> ...
>
> The display of colors in the liquid crystal display panel is based on three primaries, red, green and blue, and the shifts in these three primaries are adopted for evaluation of color shifts. In a liquid crystal display panel, since all of display colors are produced by a combination of three primaries, the color shift in all of colors can be substantially evaluated by the color shift in the three primaries.

Yanagawa, col. 5, lines 60 – 67, and col. 6, lines 49 – 55, emphasis added. Thus, in Yanagawa there is no "target" color space defined by at least N+1 target primary colors. There is only the three-primary color space.

Moreover, the triangles with which Yanagawa is concerned are the <u>triangles bounded by the R', G' and B' primary colors and the R", G" and B" shifted primary colors, and not those formed with the white point W</u>. Yanagawa states:

> In the color liquid crystal display device, *the chromaticity coordinates of three display primaries, R', G' and B'* vary with viewing angle. When the points R', G' and B' shift toward the point W', the gamut of reproducible colors is narrowed. For example, as shown in FIG. 2, when the points R', G' and B' shift to the points R", G" and B" at a viewing angle, the gamut of colors reproducible by the liquid crystal display device at the viewing angle is *within a triangle with apexes at the points R", G" and B".* At this time, the colors corresponding to the points R', G' and B' cannot be reproduced and also the gamut of reproducible colors is significantly narrowed.
>
> This shows the degree of shifts in R', G'and B' toward W' with viewing angle can be a measure for determining an area of uniform color in the color liquid crystal display device.

Yanagawa, col. 6, lines 1 – 15, emphasis added. Yanagawa merely provides a figure of the well known CIE 1931 chromaticity diagram that happens to show triangular regions of a three-primary color space. This passage clearly shows that Yanagawa does not provide a teaching that is relevant to the color space conversion techniques disclosed in Childs.

The Office Action states that it would have been obvious to one of ordinary skill in the art at the time of the present invention to shift the colors in the gamut of reproducible colors as taught by Yanagawa and use it in the system of Childs because the degree of shifting the primary colors towards the white displayed in maximum brightness at a viewing angle can be a measure for determining an area of uniform color in the color liquid crystal display device." (Office Action at page 3, and at page 11.)

While it is true that Yanagawa is concerned with improving the viewing angle of images displayed on an LCD display, Applicant respectfully submits that neither Childs nor Applicant mention viewing angle issues in their respective disclosures. Applicant respectfully submits that, even if a person of ordinary skill would have interpreted FIG. 2 as disclosing triangles bounded by an interior point, such a person of ordinary skill would not have been motivated to modify the triangular regions in Childs to be defined by at least two target primary color points and an interior color

point on the basis of FIG. 2 in the Yanagawa reference or the discussion therein of viewing angle problems in three-primary color LCD displays.

Given the discussion in Childs quoted above of the problems raised when the triangular regions do not happen to contain the balance point of the display, and the fact that Yanagawa is concerned with viewing angle problems associated with a three-primary display, Applicant respectfully submits that (1) the combination of Childs and Yanagawa does not teach Applicant's invention as claimed in claims 1 and 11, and (2) that, given the fact that the triangular regions that Yanagawa is concerned with are those bounded by the three primaries, a person of ordinary skill would not have even recognized that the triangular regions in Childs could have been modified to be defined by two primaries and an interior color point.

Regarding claims 3 and 13, the Office Action states that the interior color point D65 is the white point of the target color space. Applicant respectfully submits that this may be correct, but each of these claims includes all of the limitations of the claim from which it depends, and it has been shown above that the regions formed by Childs, or the combination of Childs and Yanagawa, are not bounded by at least two of the at least N+1 primaries and by interior color point D65, as required in claims 1 and 11.

For the foregoing reasons, Applicant respectfully submits that claims 1 and 11 is not obvious in view of the combination of the Childs and Yanagawa references, and so are in condition for allowance. As to claims 2 – 10 and 12 - 20, since these claims depend from now-allowable claims 1 and 11, these claims are also allowable and should be passed to issue with Claims 1 and 11.

Claims 10 and 20

The Office Action rejects Claims 10 and 20 under 35 U.S.C. 103(a) as being unpatentable over the combination of Childs and Yanagawa, and further in view of Ito (US 4,989,079), hereinafter "Ito."

Claim 10 depends from Claim 9, which recites wherein the step of selecting one of said solution matrices for rendering said source color point with said target primaries comprises determining in which region said source color point resides. Claim 10 as amended further limits the step of determining which region said source color point resides as comprising determining the hue angle of said source color point, and using said hue angle to select the region in which said source color point resides. Claims 9 and 10 include all of the limitations of claim 1, which includes the steps of calculating a solution matrix for each said region, and for a given color point in said source color space, selecting one of said solution matrices. Thus, claims 9 and 10 further limit the selecting step of Claim 1 for selecting a solution matrix.

Claim 20 depends from claim 19, which recites the image processing system of Claim 11 wherein the processing circuitry is further configured to determine in which region said source color point resides. Claim 20 further limits the processing circuitry to be further configured to determine the hue angle of said source color point and to determine from said hue angle in which region said source color point resides.

As a preliminary matter, Applicant respectfully submits that claims 10 and 20 are patentable because they depend from claims 1 and 11, which are patentable for the reasons stated above.

The Office Action finds that Ito teaches calculating the hue, interpreted to be the hue angle, of a signal, interpreted to be a color point, on the basis of the density ratio of three primaries, and based on the hue of the input signal, interpreted to be a color point, it is determined which of six hue areas, interpreted to be regions, it belongs to, citing to FIG. 12, col. 16 lines 35 – 76, and col. 17, lines 1 – 42 in Ito for these teachings.

The Office Action then states that it would have been obvious to one of ordinary skill in the art at the time the invention was made to calculate hue of a color point to determine it's region of location as taught by Ito and apply it into the method of Childs and Yanagawa because calculating the hue on the basis of the ratio of spectral densities improves color harmony at the boundary between hue areas.

Applicant provided extensive remarks regarding the teachings of the Ito disclosure in the Reply filed on 20 December 2006. Applicant incorporates by reference those Remarks herein, and summarizes them here.

The Ito reference is concerned with converting input image signals to output color image signals used for printing, and converts color points specified in an input three-color additive source color space of RGB to an output three-color subtractive target color space of CMY (or CMYK, where K is considered to be black.) Applicant respectfully submits that Ito identifies the hue of the input color signal in order to ultimately determine color correction parameters for printing ink densities, and not to select a conversion matrix. This is necessary because the "additivity rule of densities" does not hold in the subtractive color system of printers, making it impossible to make coincide a theoretical color corresponding to the ratio of amounts of the respective toners used in printing and the corresponding actual printed color.

In the case of the Childs disclosure, one needs only to convert a source color point into its chromaticity coordinates in the CIE color space or to its CIE XYZ tristimulus values (which is implicitly accomplished by each conversion matrix) to determine in which one of the three triads/regions of the target color space formed by the four display primaries R_d, G_{1d}, G_{2d} and B_d in FIG. 5 a source color resides. Knowing in which region the source color point resides in turn determines which of the conversion matrices is used to perform the color conversion. See Childs at pages 12 and 15 – 22, and the hardware implementation shown in FIG. 4. A hue angle as taught in Ito is simply not needed to determine the appropriate conversion matrix.

Moreover, it can be seen that the regions or triads of Childs shown in FIG. 5 are not regions that are determined according to hue. Each region, in fact, appears to have colors of many hues, especially the largest triad region formed by display primaries R_d, G_{3d} and B_d. Thus, using hue to determine in which of the three regions of the target color space formed by the four display primaries in FIG. 5 a source color resides would not produce a unique result. Thus, Applicant respectfully submits that

a person of ordinary skill would not use hue in the combination of Childs and Yanagawa because it would not uniquely select the appropriate conversion matrix to use to convert the input color to the output color.

Therefore, Applicant respectfully submits that making the combination of teachings in the Childs, Yanagawa and Ito references would not in fact produce the method and image processing system of Applicant's claims 1 and 11.

For the foregoing reasons, Applicant respectfully submits that claims 10 and 20 are patentable over the asserted combination of Childs, Yanagawa and Ito, and are in condition for allowance.

Claims 4 and 14

The Office Action rejects Claims 4 and 14 under 35 U.S.C. 103(a) as being unpatentable over the combination of Childs and Yanagawa, and further in view of Herbert (US 2004/0111435), hereinafter "Herbert."

As a preliminary matter, Applicant respectfully submits that claims 4 and 14 are patentable because they depend from claims 1 and 11, which are patentable for the reasons stated above.

The Office Action cites paragraph [0025] as teaching the use of an off white point of a lamp's light as the white point of that illuminant. Paragraph [0025] partially reads as follows:

> [0025] The calibration methodology is further explained in FIG. 2. Step 30 involves initializing the video Look-Up Table (LUT) to default values prior to measuring the white point. A LUT is a data structure that maps color indexes, or color space, to actual color values such as RGB. The "white point" is the whitest white of an illuminant that can be produced in a color space. For example, outdoors sunlight reflected off white generally serves as the white point for that illuminant. In a room at night, a single lamp's light reflected off white serves as the "white point" for that illuminant. Step 31 shows the step of modifying the LUT according to the white point measurements in the previous step. The end points of the LUT are modified using the white point as a scalar value so that the total color difference is less than 0.2 unit,

> DE*ab. The LUT is adjusted until the desired white point values are obtained from 100% white to 0% black. …

Applicant respectfully submits that the word "off" is used in this context as a preposition in the phrase "reflected off", rather than as an adjective in the color "off-white." It is more likely that Herbert intended to say "[f]or example, outdoors sunlight reflected off <u>the color</u> white generally serves as the white point for that illuminant." Applicant respectfully submits that Herbert does not teach "said interior color point is an off-white color point of the target color space," as required by these claims.

For the foregoing reasons, Applicant respectfully submits that claims 4 and 14 are patentable over the asserted combination of Childs, Yanagawa and Ito, and are in condition for allowance.

<u>Claim 21</u>

The Office Action rejects Claim 21 and 30 – 33 under 35 USC 103(a) as being unpatentable over Childs, in view of Kasson (US 5,450.216) and further in view of Ito. Claim 32 is discussed separately below.

Claim 21 as amended is directed to a system for converting source image data color points from a source color space to a target color space, wherein said source color space is defined by N source primary color points and said target color space is defined by at least N+1 target primary color points. The system comprises input means for accepting source image data color points, a hue angle calculator configured for calculating hue angles for the source image data color points, a gamut converter configured for optionally fitting the gamut of the source color space to the gamut of said target color space using the calculated hue angles, and a multi-primary converter configured for converting said source image data color points from the N-primary source color space into image data values for rendering in the at least N+1 primary target color space using one of a plurality of conversion matrices; wherein the multi-primary converter is further configured to select said conversion matrix using the calculated hue angles.

The Office Action finds that Childs discloses the multi-primary converter of Claim 21. The Office Action also finds, however, that Childs does not explicitly teach the hue angle converter or the gamut converter.

The Office Action further finds that Kasson teaches to compute the hue angle as the arctangent of the ratio of the two chrominance components, interpreting this as teaching a hue angle calculator, and citing FIG. 5 and col 8, lines 58 – 68. The Office Action further finds that Kasson teaches a gamut converter for optionally fitting (mapping) the gamut of the source color space (out-gamut points) to said target color space (device-dependent gamut) using the calculated hue angles, citing FIG. 5, col 8, lines 32 – 37 and lines 58 – 68, and col. 9, lines 48 – 65. The Office Action then concludes that it would have been obvious to one of ordinary skill in the art at the time of the present invention to calculate and use hue angles for gamut mapping as taught by Kasson and apply it into the method of Childs because using hue angles helps luminance variations at low spatial frequencies to which humans are relatively insensitive.

The rejection of claim 21 herein has been maintained from the previous Office Action. Applicant provided extensive Remarks commenting that the amendments made to claim 21 overcame this rejection in the Reply filed on 20 December 2006. The current Office Action provided no response to those arguments. Applicant repeats the same arguments again herein.

As a preliminary matter, the Childs disclosure comments on how out-of-gamut (out-gamut) colors are handled in the color space conversion techniques disclosed therein, by stating that "[i]t is important, however, to also consider what happens to colours outside this gamut; the system should "fail gracefully" under such conditions, and should not behave in an unacceptable manner." Childs, at page 23 in the first paragraph of the section labeled "9." Childs goes on to state that handling colors in "region 4" of FIG. 7 is "more complex" and region 4 is further subdivided into sub-regions, which are shown in FIG. 8:

> These sub-regions are shown enlarged in Figure 8. In sub-region 4a, … the displayed colour shifts towards the R_d primary.
>
> Similarly in sub-region 4c, …[t]he colour moves towards the B_d primary.
>
> In sub-region db, … [t]he final displayed colour is still on the line joining G_{1d} and G_{2d}, therefore, but its exact position on that line is harder to determine. In general, as the original colour moves along any particular arc AB, the displayed colour will move along the corresponding line A'B'. As the arc of colours becomes more saturated (e.g. the arc CD), so the length of the corresponding line C'D' becomes longer. In general, therefore, saturation changes in the incoming colours can produce hue changes in the reproduced colour. Nevertheless, it can be seen from Figure 8 that these hue changes are relatively minor (similar in magnitude to the hue changes that might be produced by saturation effects in present-day coding systems). Thus the performance of the four-primary display is unlikely to produce unacceptable colour errors in any part of the visible spectrum.

Childs, at page 24. Childs seems to suggest, therefore, that an explicit gamut converter configured for fitting the gamut of the source color space to the gamut of the target color space using calculated hue angles is neither desirable nor needed in the color space conversion system disclosed therein, and so this languages <u>teaches away</u> from making the combination of Childs and Kasson asserted in the Office Action.

Claim 21 recites a multi-primary converter configured for converting said source image data color points from the N-primary source color space into image data values for the at least N+1 primary target color space using one of a plurality of conversion matrices; <u>wherein the multi-primary converter is further configured to select said conversion matrix using the calculated hue angles</u>. As noted earlier in the discussion of the combination of Childs, Yamagawa and Ito, the Office Action finds, with respect to claims 10 and 20 that the Childs reference does not explicitly provide any teachings with respect to hue angle. The Office Action cites Ito as teaching the use of the calculated hue angles to select the conversion matrix.

As already noted above, (1) in the case of the Childs disclosure, one need only to convert a source color point into its chromaticity coordinates in the CIE color

space or to its CIE XYZ tristimulus values (which is implicitly accomplished by each conversion matrix) to determine which of the conversion matrices is used to perform the color conversion; (see Childs at pages 12 and 15 – 22, and the hardware implementation shown in FIG. 4); and (2) using hue or hue angle to determine in which of the three regions of the target color space formed by the four display primaries in FIG. 5 a source color resides <u>would not produce a unique result</u>. Thus, Applicant respectfully submits that a person of ordinary skill would not use hue because it would not uniquely produce the correct conversion matrix to use to convert the input color to the output color.

Since Kasson teaches calculating hue angles for the purpose of gamut fitting (mapping), Kasson also does not teach a multi-primary converter further configured to select said conversion matrix using the calculated hue angles.

Therefore, the Office Action fails to state a *prima facie* case of obviousness with respect to claim 21 because the Applicant respectfully submits that the asserted combination does not actually teach each of the elements of claim 21.

For the foregoing reasons, Applicant respectfully submits that claim 21 is patentable over the asserted combination of Childs and Kasson, and is also in condition for allowance. As to new claims 30 and 31, these depend from now allowable claim 21, and so are also in condition for allowance.

<u>Claim 32</u>

The Office Action rejects Claim 21 and 30 – 33 under 35 USC 103(a) as being unpatentable over Childs, in view of Kasson (US 5,450.216) and further in view of Ito.

Claims 32 is directed to an image processing system for converting an input N-valued color image data value in a source color space to an N+1-valued color image data value in a target color space. The source color space is defined by N primary color points and the target color space is defined by at least N+1 primary color points in the target color space, wherein N is an integer. The image processing system comprises a display for displaying image data in said target color space

defined by said at least N+1 primary color points; and processing circuitry configured for accepting said input N-valued color image data value, and configured for producing said N+1-valued color image data value in said target color space for rendering on said display. The processing circuitry is further configured for calculating a hue angle for said input N-valued color image data value, for selecting conversion data using said hue angle, and for using said selected conversion data to produce said N+1-valued color image data value in said target color space.

The Office Action references the discussion of claim 21 for the asserted teachings of the limitations of the processing circuitry being configured for calculating a hue angle for said input N-valued color image data value, for selecting conversion data using said hue angle, and for using said selected conversion data to produce said N+1-valued color image data value in said target color space. However, the language in claims 21 and 32 are different, and are not necessarily parallel.

Thus, Applicant assumes that Kasson is being cited as teaching processing circuitry configured for calculating a hue angle for said input N-valued color image data value and for selecting conversion data using said hue angle. Since Claim 32 does not include limitations related to regions of the target color space and determining in which region an input color value resides, Applicant assumes that the Ito reference is <u>not</u> part of the combination of references that forms the basis of this rejection. If Applicant has made an incorrect assumption, clarification of this rejection is requested in the next communication.

Applicant respectfully submits that Kasson teaches calculating hue angles for the purpose of gamut fitting (mapping). In Kasson, the technique illustrated in FIG. 5 produces an output data value in the output gamut using chrominance correction techniques. Hue angle is used to obtain a maximum chroma value in the output gamut; hue angle does not appear to be used to select conversion data.

Therefore, the Office Action fails to state a *prima facie* case of obviousness with respect to claim 32 because the Applicant respectfully submits that the asserted combination does not actually teach each of the elements of claim 32.

For the foregoing reasons, Applicant respectfully submits that claim 32 is patentable over the asserted combination of Childs and Kasson, and is also in condition for allowance. As to claim 33, this claim depends from now allowable claim 32, and so is also in condition for allowance.

Conclusion

In view of the foregoing amendments and remarks, Applicant respectfully submits that all pending Claims are patentable over the cited art of record and are in condition for allowance. Therefore, Applicant requests the Examiner to reconsider and withdraw the outstanding rejections and pass this application to allowance.

If the Examiner believes a telephone conference would expedite the allowance of the claims, the Examiner is invited to contact Judith C. Bares at (408) 200-7386.

Respectfully submitted,

/Judith C. Bares/

Judith C. Bares Reg. No. 35,824

Dated: July 6, 2007

Attachments to this amendment by separate submission:

Two (2) Annotated Sheets showing changes made to Figures 6 and 8.

Two (2) Replacement Sheets including FIGS. 5 and 6, and FIGS. 7 and 8, in their amended form.